NASAfacts

Robotic Refueling Mission

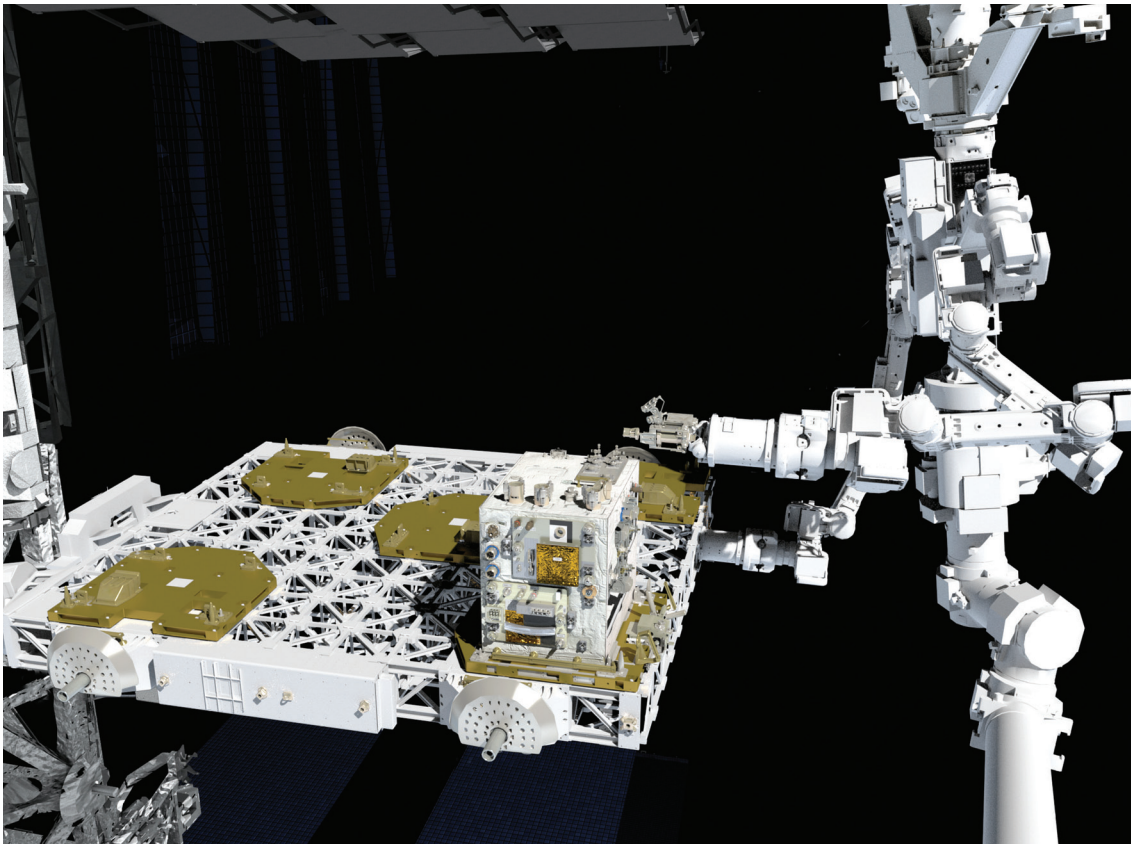
NASA's new Robotic Refueling Mission (RRM) is an external International Space Station experiment designed to demonstrate and test the tools, technologies, and techniques needed to robotically refuel satellites in space—especially satellites not designed to be serviced.

A joint effort between NASA and the Canadian Space Agency (CSA), RRM is scheduled to launch to the station on STS-135, the final planned shuttle mission. This would be the first on-orbit attempt to test robotic refueling techniques for spacecraft not built with on-orbit servicing in mind, and is expected to reduce risks and lay the foundation for future robotic servicing missions.

Robotic Tools and Technology in Action

Before a satellite leaves the ground, its technicians fill its fuel tank through a valve that is then triple-sealed and covered with a protective blanket — designed never to be accessed again. RRM will test whether a robot can remove these barriers and refuel such a satellite in space through a series of activity boards and four unique RRM tools specially designed to get the job done.

The best way to visualize RRM's mission is to think of Dextre, the space station's twin-armed Canadian robotic "handyman," as a skilled spacecraft refueling technician. Dextre was developed by the CSA to perform delicate assembly and maintenance tasks on the station's exterior as an extension of its 57-foot-long (17.6 meter) robotic arm, Canadarm2. The RRM box, which will be mounted on an external space station platform, includes protective thermal blankets, caps, valves, simulated fuel, and other components that need to be pushed back, cut through, unscrewed and transferred. Each component and activity board represents an individual refueling or servicing task, and each RRM tool is designed to efficiently complete a wide range of targeted activities.



Artist's concept of the International Space Station's Dextre using customized tools to demonstrate a variety of robotic refueling servicing tasks on the Robotic Refueling Mission box.

For instance, to fill up RRM's fuel tank with a simulated fuel, Dextre's robotic "hands" would retrieve the Nozzle Tool from RRM, securely connect the tool to the fuel valve on the RRM box, and transfer the simulated fuel through the valve. While such activities are similar to grabbing a fuel nozzle at the gas station and filling up a car's gas tank, each RRM task requires a high level of robotic precision and demonstrates state-of-the-art refueling technology, tools and techniques.

RRM was designed by the Satellite Servicing Capabilities Office (SSCO) at NASA's Goddard Space Flight Center in Greenbelt, Md. Since many of RRM's activity boards are interchangeable, they can be switched out to demonstrate additional robotic servicing tasks for future robotic refueling missions.

What Makes RRM Unique

- First NASA technology demonstration to test and prove technology needed to perform robotic refueling on spacecraft not built to be refueled
- First use of Dextre beyond robotic maintenance of the space station for technology research and development

Mission Development and Operations

Drawing upon 20 years of experience servicing the Hubble Space Telescope, Goddard's SSCO initiated the development of RRM to demonstrate the feasibility and practicality of robotically refueling and servicing satellites on-orbit.

The NASA Goddard Satellite Servicing Development Facility in Greenbelt, Md., was used to develop, test, and verify the technology, tools, and techniques needed to execute RRM.

After STS-135 docks, RRM will be transferred by a spacewalking astronaut to Dextre's Enhanced Orbital Replacement Unit Temporary Platform (EOTP). Following the shuttle's departure, RRM will remain on the EOTP, and Dextre and Canadarm2 will transfer RRM to its permanent location on the station's truss at the EXpedite the PRocessing of Experiments to Space Station (EXPRESS) Logistics Carrier-4 (ELC-4). RRM operations will be entirely remote controlled by flight controllers at Goddard, Johnson Space Center in Houston, Marshall Space Flight Center in Huntsville, Ala., and the CSA's control center in St. Hubert, Quebec.

RRM Tools

The RRM box will launch to the space station with four unique tools developed at Goddard: the Wire Cutter and Blanket Manipulation Tool, the Multifunction Tool, the Safety Cap Removal Tool, and the Nozzle Tool. Each tool is stored in its own storage bay in the RRM box until it is retrieved by the robotic Dextre "hands" for use. Tools have integral cameras for ground operator vision and include specialized features tailored to complete each task. The tools' primary functions are to cut and manipulate wires, unscrew caps, open and close valves, and transfer fluid.

RRM Tasks

During the mission, RRM will cut and manipulate protective blankets and wires, unscrew caps and access valves, transfer fluid, and leave a new cap in place for future refueling activities. The experiment also will demonstrate general robotic operations.

Timeline

The RRM experiments are designed to be executed in two phases.

- Phase 1: Use robots together with Goddard and CSA robotics simulations on Earth to develop, test, and verify the robotic tools and techniques needed to execute RRM (2009 until 2011 launch).
- Phase 2: Use the space station and its robots as a platform to demonstrate a full set of robotic refueling tasks and other general robotic operations (launch plus up to two years after space station RRM operations begin).

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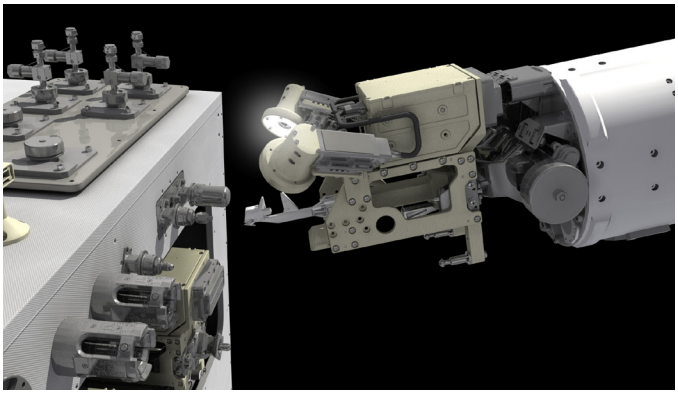
Or visit the SSCO website at:
http://ssco.gsfc.nasa.gov

For more information about the International Space Station, visit;
www.nasa.gov/station

For more information about Dextre, visit:
www.asc-csa.gc.ca/eng/iss/dextre/



Arist's concept of the Wire Cutter and Blanket Manipulation Tool approaching RRM to cut the wire on a sealed cap. Integral cameras with built-in LEDs light the way and give Mission Controllers a front-seat view of the tool's action.

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